man in South America to a time which must be measured by thousands of years.

It seems to us a herculean task to attempt to unravel the ethnology of Peru, which we suspect can only be adequately done in connection with that of the whole American continent; but it is a task which is well worth attempting. A vast amount has been written on the subject, and there exists a great wealth of material; it seems to us that

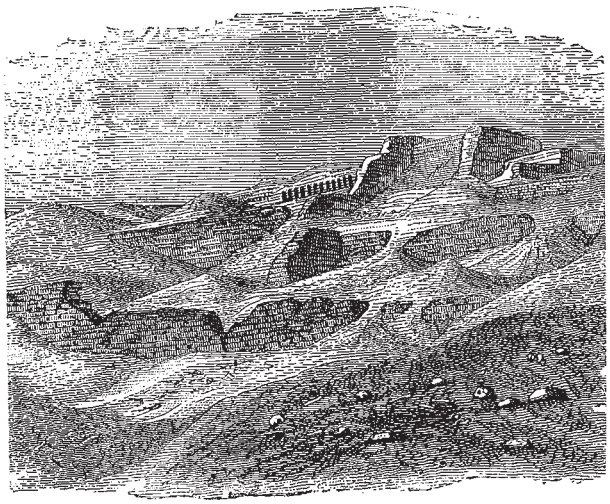

FIG. 4.—Ruins of Reputed Temple of the Sun at Pacha-cámac.—Hutchinson.

what is now wanted is a man possessed of the necessary wide grasp of mind and extensive knowledge to set himself to collect, arrange, and sift this material and investigate on strict scientific principles the bearing of the results. From such a process, we believe, some definite

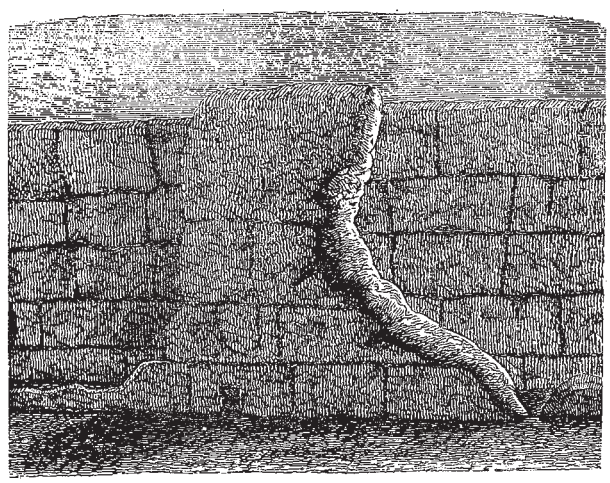

FIG. 5 —Part of Ruins of Double Wall of Temple of Rimac.—Hutchinson.

and valuable conclusions would be arrived at, as definite, perhaps, though not nearly so comprehensive, as those which have been reached concerning the Indo-European peoples; for there still remains much material to bring together, and no time should be lost in setting about the work. Mr. Hutchinson suggests that if some one would do for the remains in Peru what Schliemann has done for those of Troy, and George Smith has done for those in Assyria, the results would be of higher value than any yet achieved. Let some one with the patience, enthusiasm, and knowledge of Dr. Schliemann, devote the necessary time to the careful excavation and study of the mounds and clay-covered buildings, and we are sure the results will well repay the labour. Let us hope that the present Peruvian Government will be patriotic and generous enough to inaugurate and bear the expense of the work, and thus gain for themselves the admiration and thanks of the civilised world. Talking of Dr. Schliemann, Mr. Hutchinson points out some very remarkable coincidences between the buildings and relics which that explorer has unearthed, and those which Mr. Hutchinson himself has found in Peru. Whether this be more than a coincidence it would be rash at present to conjecture.

Mr. Hutchinson's work must be regarded as one of the most important contributions that have been made to the archæology of Peru, and we hope that though no longer resident in the country, he will continue to investigate the subject and help to reduce its present confusion to something like order. We think, however, he might have a little more patience with the theories of other investigators, and not hastily cast them aside as unworthy of notice; the labours of all competent and earnest workers should be seriously studied, for thus only can the full truth be arrived at; even in the legends of Garcilasso he might find some speck of valuable truth.

WATSON'S "DESCRIPTIVE GEOMETRY"

A Course in Descriptive Geometry. By William Watson, Ph.D. 4to. double columns, pp. xi., 147, with thirty-two plates and three double plates of stereoscopic views. (Boston: Osgood and Co. London: Longmans, Green, and Co., 1874.)

DESCRIPTIVE Geometry affords the practical means of dealing with geometry in three dimensions, in the same manner that Practical Geometry, that is to say, the intelligent use of drawing and of graphical methods, deals with plane geometry. If, in solid geometry, we concerned ourselves only with points and with lines, whether straight or curved, we might say that descriptive geometry was simply the science of plan and elevation. As regards the point and the line, it is nothing more. But what distinguishes descriptive geometry, as it was published to the world in Monge's celebrated treatise, from what was already known to every intelligent builder or carpenter, is the means of *indicating* surfaces, whether plane or curved, as well as of *representing* points or lines. We use the terms *indicating* and *representing* advisedly, as carrying with them a real distinction, which, we regret to see, is not always brought prominently forward in the treatises, and sometimes fails to be perceived by the student until he has wasted valuable time in groping after a misapprehension. It is indeed evident that a surface cannot be represented in the same sense that a point and line are, for its plan and elevation would be simply two black patches, the contours of which would give the boundaries of the surface in certain directions, but would fail to represent the surface itself. Now, the method published by Monge regarded a surface, whether plane or curved, as completely indicated so soon as its geo-

metrical law of generation was described and the position and aspect of its principal elements indicated on the paper.* Its indication was then complete, and the representation of any points or lines upon it was then reduced to the devices of practical geometry. The principle simply was that a surface might be regarded as completely known when we had indicated a method of taking an infinite number of sections of it. In the simplest case, these would be parallel plane sections, as in the ordinary drawings of a ship, but Monge's method was not trammelled by this restriction.

Like most large subjects, it is one which it is very difficult to know how to treat with advantage to the student. An exhaustive treatise is out of the question for any learner who is not prepared to make it an exclusive or principal study, and it is a matter of very nice judgment what to select and how much to present to the pupil; and this is the more emphatically so, inasmuch as it is really the only good introduction to a practical insight into the geometrical properties of space.

Viewed in this light, the treatise before us is an exceedingly good one. With great clearness and precision, it covers a considerable extent of ground, and that by no means baldly; and yet it is not too long. It has, moreover, a very valuable adjunct, and one which, we believe, is quite new—a series of stereoscopic drawings exhibiting the actual construction *in solido* of thirty-six of the principal problems. To the ordinary student this will be of immense assistance; for it is well known to teachers of geometry and of mechanics, that want of imagination on the part of the student is one of the principal obstacles they have to deal with in endeavouring to impart to him accurate conceptions of space and of motion. These drawings have been very clearly and judiciously executed by Prof. Saint Loup (of Paris), and slight colouring has been introduced in some of the examples of intersection with marked advantage and success.

We notice some peculiarities of language in which English usage is slightly departed from, as in writing *warped* surfaces instead of skew surfaces, in spelling the word *directer* with two *e's* instead of "director," and in the use of the word *raccord* to express that two surfaces have a line of contact. Some of these, having regard to the unsettled English nomenclature of an imported subject, are not blemishes, and none of them detract from the really high value of the book.

Some account is also given of the leading spherical projections, especially the orthographic and the stereographic. These are important additions to the treatise, and although we would gladly have seen some others described, particularly the gnomonic projection, we think the author has done wisely in not unduly extending this part of his treatise.

The book is of convenient size, clearly printed, and well arranged, with a good table of contents. Altogether, we think it one of the best books upon the subject which we have yet seen, especially in English, and we think it does the highest credit to the distinguished American professor who is its author.

* It is certain that Monge did a great deal to systematise and complete the method; but some of its principles were certainly known, although carefully kept secret, in some of the higher French schools. In consequence of this secrecy, it will probably never be known exactly how much is due to Monge; but we may well believe that Monge did for this science what Newton and Leibnitz did for the infinitesimal calculus.

PHILLIPS' "ELEMENTS OF METALLURGY"

Elements of Metallurgy: a Practical Treatise on the Art of Extracting Metals from their Ores. By J. Arthur Phillips, M. Inst. C.E., F.G.S., F.C.S., &c. (London: Charles Griffin and Co., 1874.)

OF all the sciences, Metallurgy is the one whose history extends into the most remote antiquity, and there is abundant evidence to show that even complicated metallurgical operations were performed empirically long before the physical sciences existed.

Until within comparatively recent times the number of eminent chemists who devoted themselves to metallurgical work was more commensurate with the importance of the subject than at the present day, when, we venture to think, too many are lured away by the attractions of organic chemistry and abstract speculations as to the existence of matter. Notwithstanding this, within the last few years the science of metallurgy has made great advances, but the works on the subject published in this country have been singularly few; Dr. Percy's admirable work is still incomplete, and, with the exception of the translation of Kerl's "Metallurgy" by Crookes and Röhrig, there is no work which is even fairly comprehensive. The edition of Mr. Phillips' "Manual of Metallurgy" published in 1858 has become almost useless, but the volume just issued is an important addition to this branch of literature.

The physical properties of metals are fully and carefully treated, and eighty pages are devoted to the consideration of fuel. The description of iron ores is very good, the author having closely followed Bauerman, and no pains have been spared to render the portion of the work which treats of iron as complete as possible. Among the numerous carefully executed engravings are drawings of roasting and calcining kilns, and of the blowing engine and blast cylinder at Dowlais.

The next important metal, copper, is discussed at some length, and the description of the "wet methods" of extracting this metal is specially valuable, as the author writes from long experience of operations which have been conducted under his own direction. It is interesting to note that processes such as those carried on at Widnes, Alderley Edge, and Jarrow-on-Tyne, are applications, on a manufacturing scale, of methods ordinarily used by the chemist in his laboratory, and, as such, they afford singularly important evidence of the progress of metallurgical science.

Lead is treated at some length, special attention being devoted to the extraction of this metal by means of reverberatory furnaces. Excellent drawings are given of those employed in the works at Couëron, where galena associated with carbonate of lead is partially converted into oxide and sulphate by roasting, which subsequently react, at a more elevated temperature, on the undecomposed sulphide in the charge, producing metallic lead.

The articles on silver and gold are condensed from the author's well-known work on the mining and metallurgy of these metals, some new matter being added; they leave little to be desired, but the forms of apparatus for assaying which are described, are not in all cases the most perfect.

Fifteen metals are treated in the work, and these are